



Comparison of storm intensity and application timing on modeled transport and fate of six contaminants

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Abstract:

Hundreds, if not thousands, of fish kills and kills of other aquatic organisms occur following storms in the US each year, but they are difficult to quantify, investigate, or manage due to the transient nature of major storms and the other priorities following them. Methods are needed to better understand the causes of these kills. The Pesticide Root Zone Model and the Exposure Analysis Modeling System were used to compare risk to resident biota in estuarine headwaters in two locations under various conditions. Contaminants were selected using a landuse-based preliminary risk assessment approach. Atrazine, fipronil, and imidacloprid were compared for potential impacts on important prey species, including copepods and grass shrimp, in Lake Bethel in Volusia County, Florida. Carbaryl, diquat dibromide, and fluoranthene were compared for potential impacts on salmon and other aquatic species in Johnson Creek, near Portland, Oregon. Predictions of contaminant concentrations in groundwater runoff, surface water, benthic sediments, and pelagic biota tissue were obtained based upon watershed characteristics, storm types, and contaminant chemistry and application. For all six contaminants, the simulated concentrations were highest following the 100-yr storms and lowest following the 2-yr storms. Aqueous concentrations ranged between 84 and 2100% higher in 100-yr compared to two-yr storms. Most atrazine and carbaryl concentrations were highest if applied one day before the storm while fipronil, imidacloprid, and diquat dibromide were highest if applied 16 days prior to the storm. Carbaryl and fluoranthene concentrations were highest in the forested segment of the watershed while diquat dibromide concentrations were highest in the agricultural segment. In Florida simulations, groundwater and surface water concentrations generally were highest for atrazine, followed by imidacloprid, and then fipronil. Atrazine poses the highest risk to algae and copepods due to its mobility and high allowable application rates. Fipronil and imidacloprid, though highly toxic, were not predicted to occur at high enough concentrations to pose a risk. In Oregon simulations, groundwater and surface water concentrations generally were highest for carbaryl, followed by fluoranthene, and then diquat dibromide. For salmonids, fluoranthene poses a higher risk than carbaryl, whereas it is unlikely that diquat dibromide will affect salmonids in this system. For crustaceans, carbaryl poses the greatest risk, followed by fluoranthene. Diquat dibromide was determined to pose little risk. These tests demonstrate the use of preliminary risk assessment, along with transport and fate modeling, to characterize risks to aquatic organisms without the need for in situ chemical measurements.

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Resource Description

Exposure : ☐

Climate Change and Human Health Literature Portal

weather or climate related pathway by which climate change affects health

Extreme Weather Event

Extreme Weather Event: Other Extreme Event

Extreme Weather Event (other): Intense storms

Geographic Feature: 

resource focuses on specific type of geography

Ocean/Coastal

Geographic Location: 

resource focuses on specific location

United States

Health Impact: 

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

Mitigation/Adaptation: 

mitigation or adaptation strategy is a focus of resource

Adaptation

Resource Type: 

format or standard characteristic of resource

Research Article

Timescale: 

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment: 

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content